

### RECRUITMENT AND STOCK ENHANCEMENT OF THE CHINESE SHRIMP, *PENAEUS ORIENTALIS* KISHINOUE (DECAPODA, CRUSTACEA)

Hatchery reared juvenile Chinese shrimp, *Penaeus orientalis*, have been restocked into Chinese coastal waters since the early 1980s so as to increase natural stocks. Surveys of the physico-chemical and biological environments have been conducted, to take advantage of natural productivity and resources. The data obtained from Jiaozhou Bay area in the Yellow Sea during 1981–1988 indicated that the released shrimp grew quickly, migrated out of the Bay to the shallow open sea, and could thus be fished during the autumn shrimp-ing season before the start of the over-wintering migration to the deeper part of southern Yellow Sea.

The recruitment of the Chinese shrimp in the Yellow Sea is unimodal (in contrast with multimodality of tropical species) and occurs from June to September with a peak in July and August. The recruitment in July constitutes over 40–50% of the annual recruitment. The total number of shrimp estimated using ELEFAN (Electronic Length Frequency Analysis) for August of 1981–1988 was indicative of the annual

stock size and might be used to evaluate and predict the effects of our restocking experiments. The stock size of the shrimp in the Bay was increased to more than 25,000 (41,500 in 1985) for years of commercial restocking (Table 1), which was about 4.5 times the maximum stock size estimated for non-stocking years (1981). The success of the releasing experiments is also reflected in the 2–4 fold increase of local shrimp catch compared with 1981.

The average survival rate of the released juvenile shrimp was estimated between 32.0–35.6%. Based on these figures and data on biological productivity and availability of natural food organisms (mainly benthic animals), the authors recommend that 70–100 × 10<sup>6</sup> juvenile shrimp be released for Jiaozhou Bay area.

Juvenile shrimp have been released in different parts of northern, eastern and southern China Sea based on the findings of these and other similar experiments. To date promising results have been achieved from these stockings.

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TABLE 1. Density and stock size of *Penaeus orientalis* in Jiaozhou Bay in August 1981–1988

Year	Commercial release (10 <sup>3</sup> ind.)	Experimental release (10 <sup>3</sup> ind.)	Average density (ind km <sup>-2</sup> )	Stock size (10 <sup>3</sup> ind)	Stock size (10 <sup>3</sup> kg)	Total Qingdao catch (ton)
1981	0	0	14,110	5,644	225.8	300
1982	0	0	1,335	534	21.4	—
1983	0	280	8,396	3,385	134.3	—
1984	37,000	2,500	66,209	26,484	741.6	640
1985	120,000	7,000	103,716	41,486	1,161.6	900
1986	200,000	47	75,725	30,290	848.1	1,140
1987	0	14	5,181	2,072	58.0	50
1988	180,000	18	63,125	25,249	707.0	840

### EFFECT OF DIETARY PROTEIN ON SEXUAL MATURITY AND EGG PRODUCTION IN THE ECONOMICALLY IMPORTANT RIVERINE PRAWN, *MACROBRACHIUM NOBILII*

The effect of dietary protein on sexual maturity and egg production was studied by feeding juvenile *M. nobilii* on one or the other of five isocaloric diets containing 10, 15, 25, 35 or 50% protein for a maximum period of 460 days. The juveniles attained sexual maturity on attaining a body weight of 600 mg after 321, 280 and 240 days, when fed on 15, 25, 35 and 50% protein diet, respectively. Thus the high protein diets (>35%) advanced the onset of maturation. Those fed the 10% protein diet died before reaching sexual maturity. The interspawning period was 45, 33, 24 or 21 days when the

prawns were fed with 15, 25, 35, or 50% protein diet respectively. During the experimental period, prawns fed a high protein diet underwent 8 adult moults, carried 5 clutches and produced an average of 4375 eggs, compared to 5 adult moults, 3 clutches and production of 2088 eggs by the group fed on 15% protein diet. Energy content of the eggs produced by the groups fed >35% protein diet was 0.76 J/egg, which is significantly more than that (0.69 J/egg) spawned by the prawns fed on the 15% protein diet.

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